

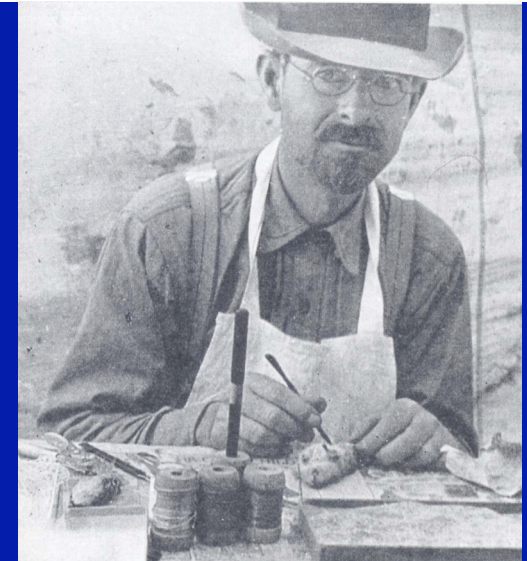
The Grinnell Project: Changes in Avian & Mammal Diversity Over the Past Century

5th Annual California Climate
Change Conference
Sacramento, Sept 9, 2008

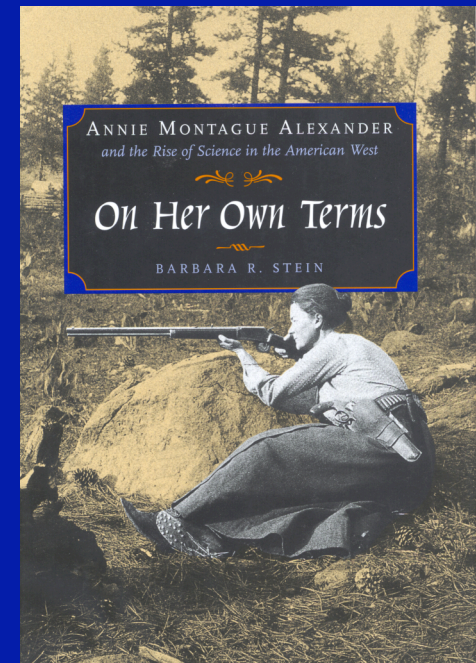
Craig Moritz, Museum of Vertebrate Zoology,
UC Berkeley; craigm@berkeley.edu

The Alexander/Grinnell Legacy

“At this point I wish to emphasise what I believe will ultimately prove to be the greatest purpose of our museum. This value will not, however, be realized until the lapse of many years, *possibly a century*, assuming that our material is safely preserved. And this is that the student of the future will have access to the original record of faunal conditions in California and the west, wherever we now work”
(Grinnell, 1910)

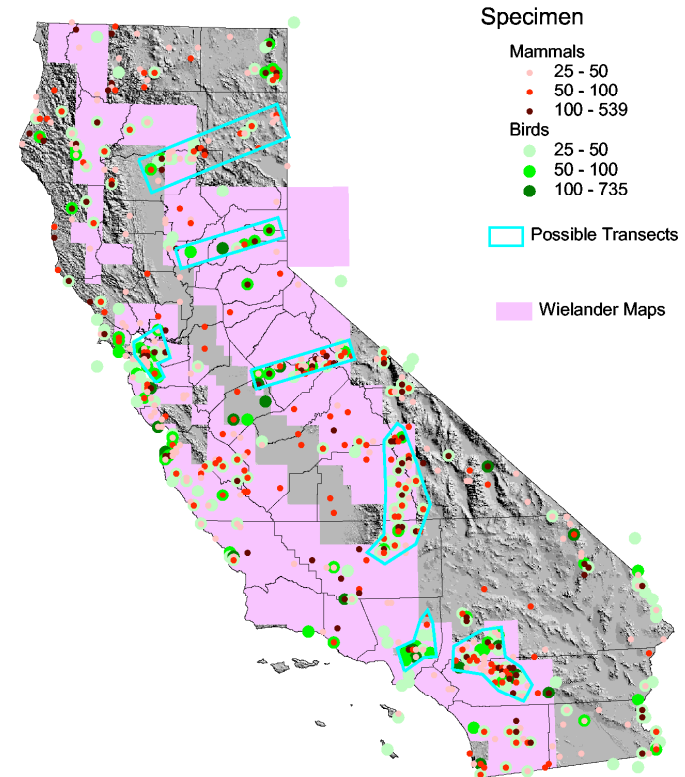
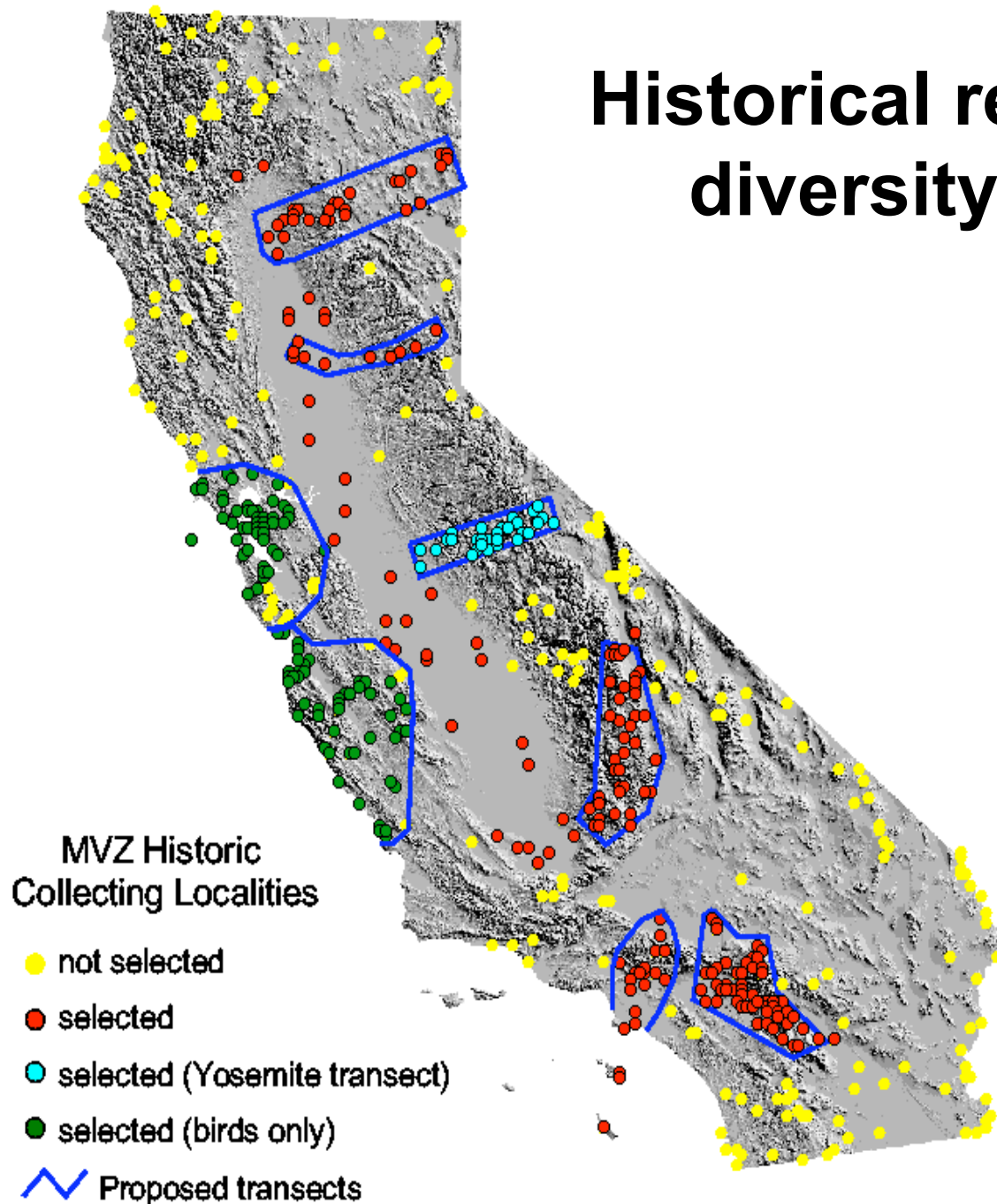


Joe Grinnell, MVZ
Director 1908-39

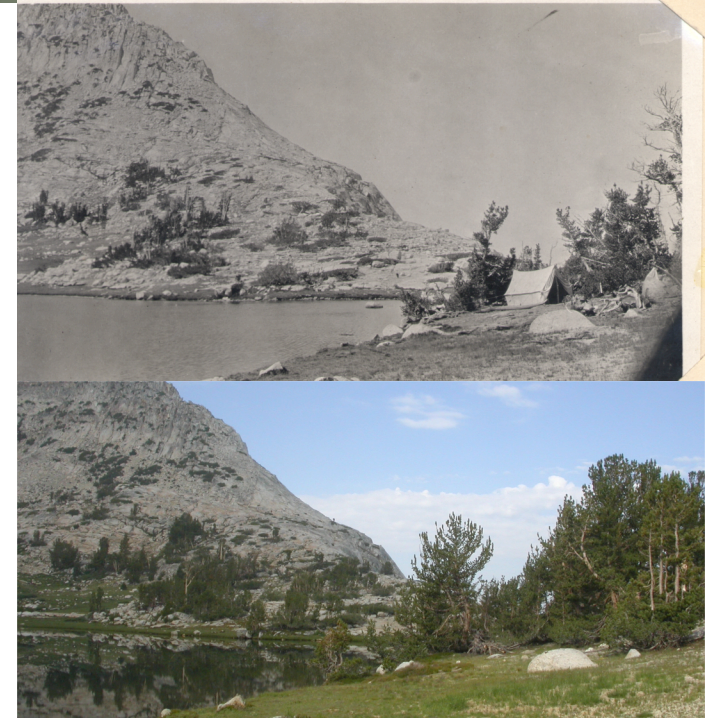
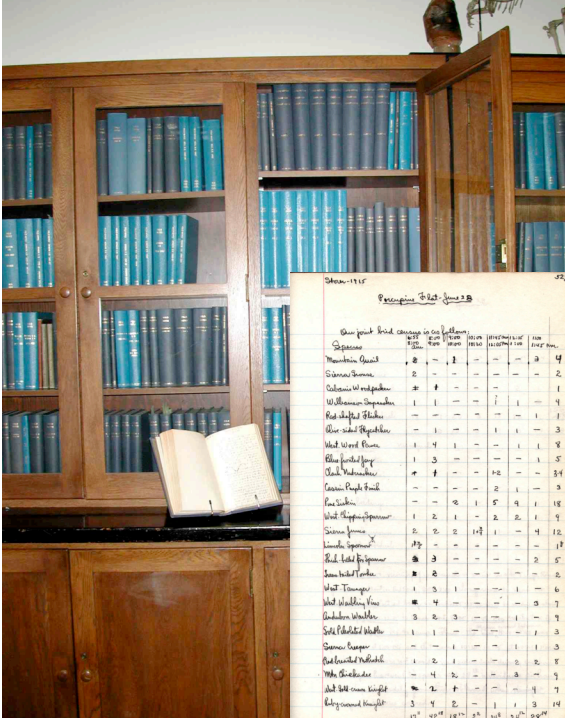


Annie Alexander: Benefactor

Historical records of faunal diversity and habitats



Wieslander veg maps
1930s- 40s



The “Grinnell Project”

Demonstrating the value of integrated museum science



Resurvey vertebrates at >200 Grinnell sites throughout California to:

- **Document** current distribution & abundance of small mammals, birds, reptiles and amphibians
- **Observe** changes over a century in community, species & genetic diversity
- **Understand** why biodiversity has changed given changes in climate, land-use etc.
- **Provide** another benchmark for assessing responses to future environmental change

ANIMAL LIFE IN THE YOSEMITE

AN ACCOUNT OF THE MAMMALS, BIRDS,
REPTILES, AND AMPHIBIANS IN
A CROSS-SECTION OF THE
SIERRA NEVADA

BY
JOSEPH GRINNELL
AND
TRACY IRWIN STORER

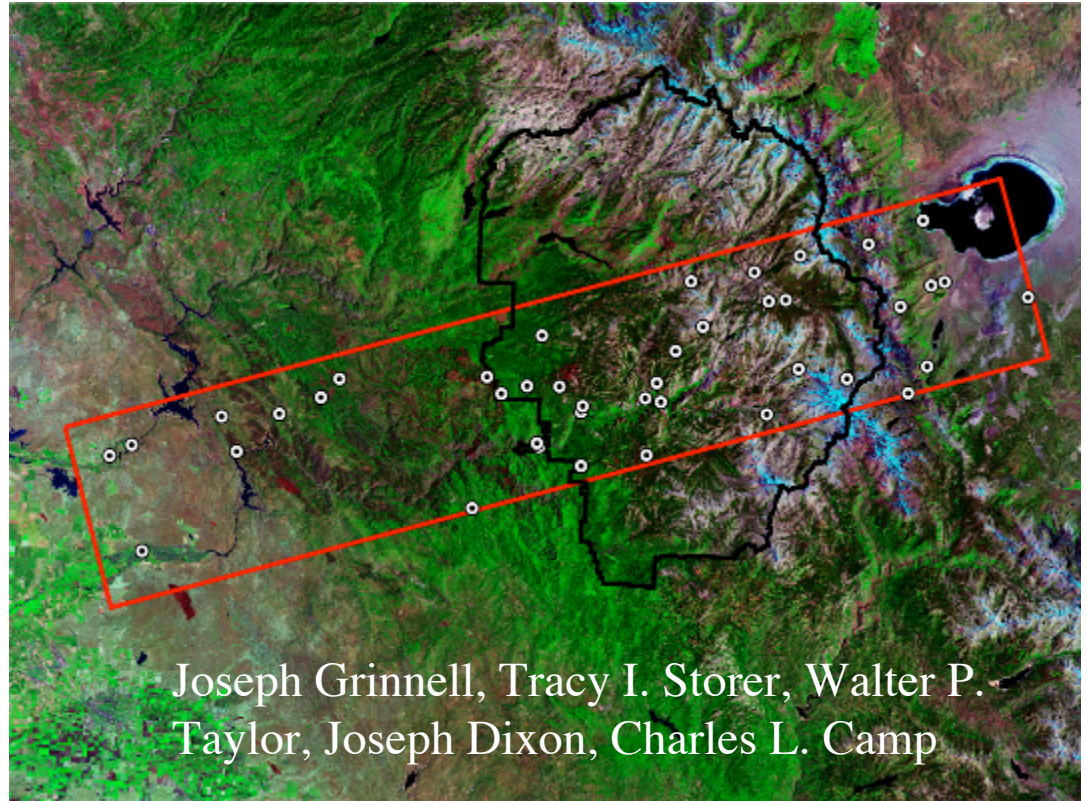
CONTRIBUTION FROM THE MUSEUM OF VERTEBRATE ZOOLOGY
UNIVERSITY OF CALIFORNIA



UNIVERSITY OF CALIFORNIA PRESS
BERKELEY, CALIFORNIA
1924

Yosemite transect

41 sites, elevational range 300 - 12,000 ft

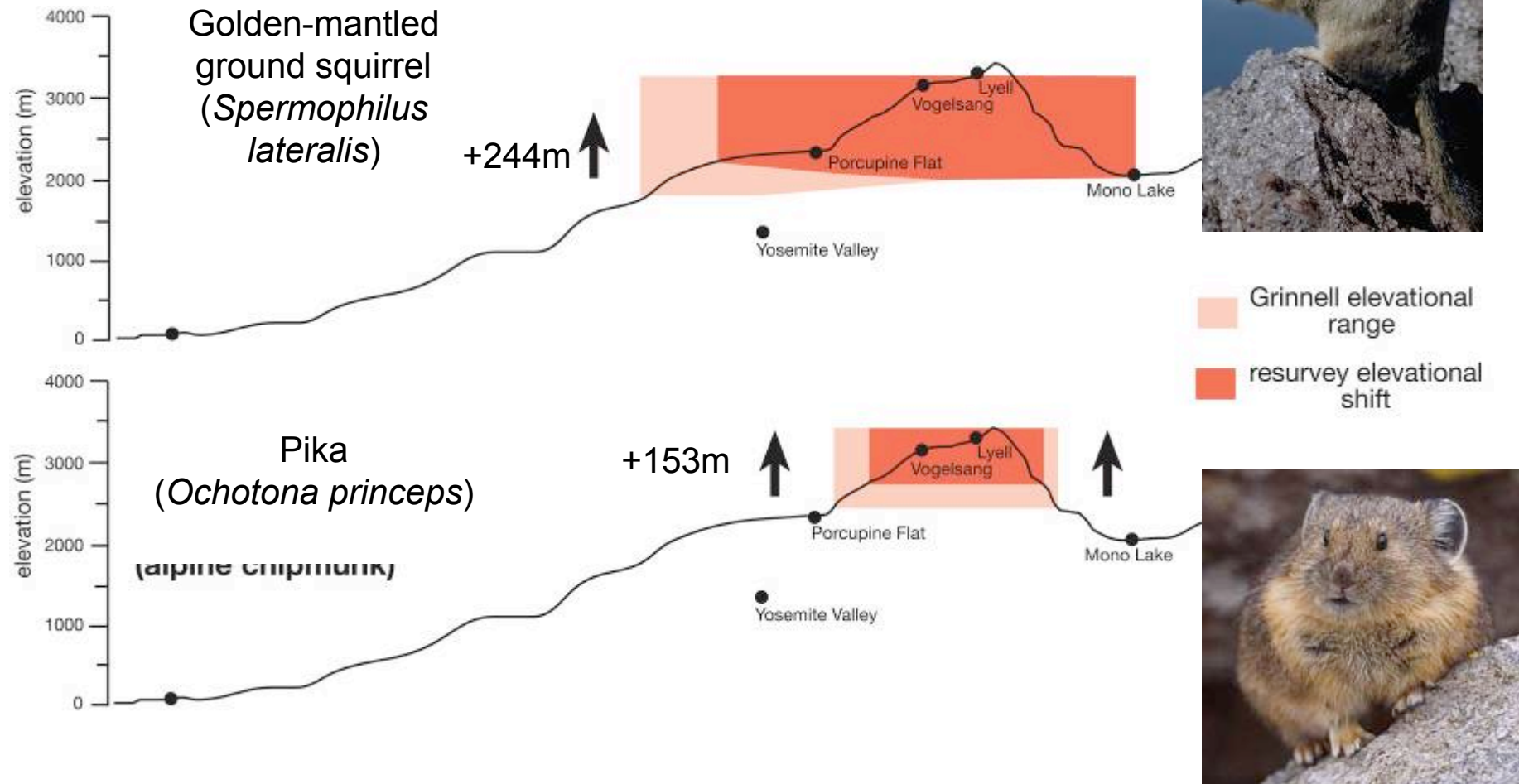


Joseph Grinnell, Tracy I. Storer, Walter P.
Taylor, Joseph Dixon, Charles L. Camp

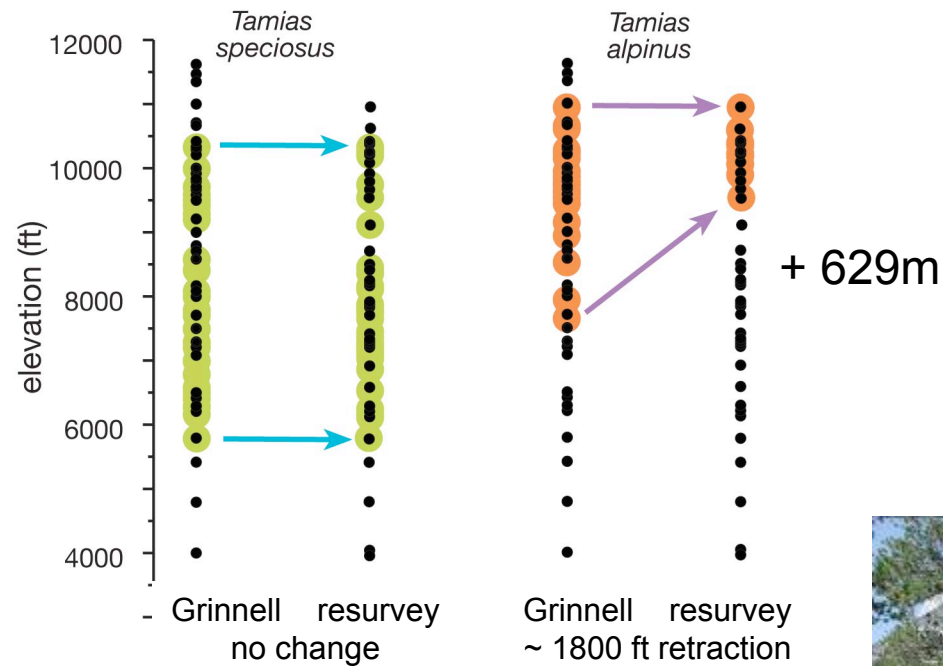
fieldwork began on 19 Nov. 1914 and
ended on 11 Aug. 1920

957 "man-days" in the field
~3,000 pages of field notes
4354 specimens obtained
~700 photographs

High elevation species: upward range retraction



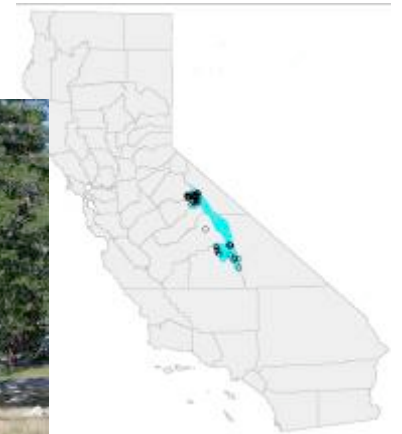
Chipmunks: distributional shifts



tree-line - 10,300 ft



lodgepole pine forest - 8900 ft

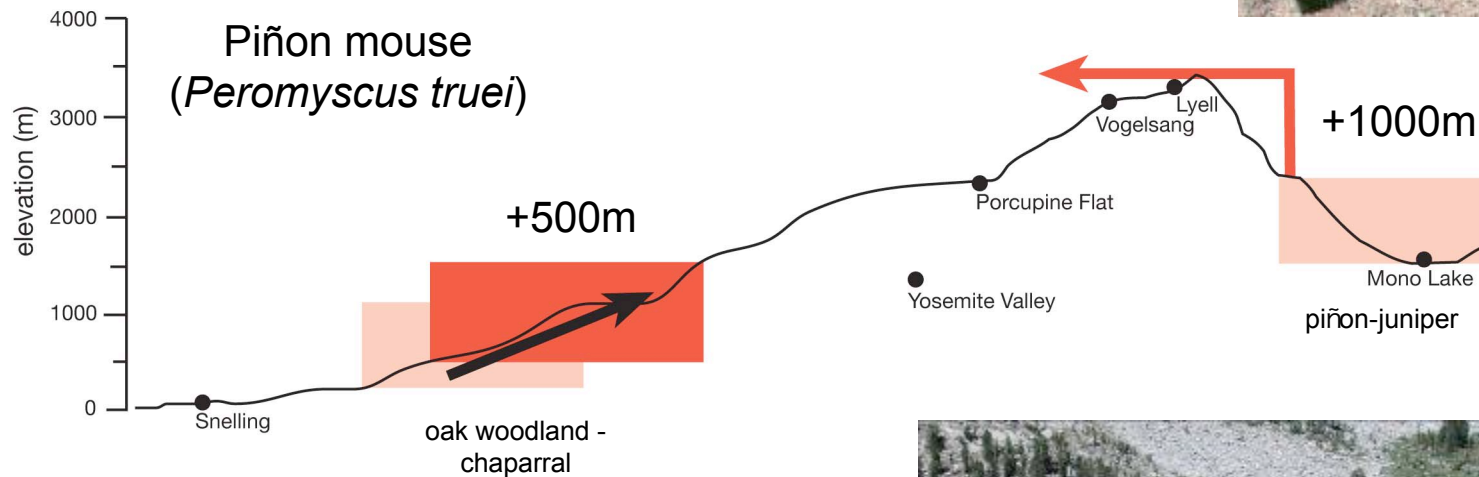


Lodgepole pine chipmunk
(*Tamias speciosus*)



Alpine chipmunk
(*Tamias alpinus*)

Low elevation species: upward expansion into higher elevation (west and east slopes) and habitat (on east side)



Mono Basin:
piñon -
juniper
woodland,
7300 ft



upper Lyell
Canyon:
whitebark pine,
10,300 ft

downward elevational expansion

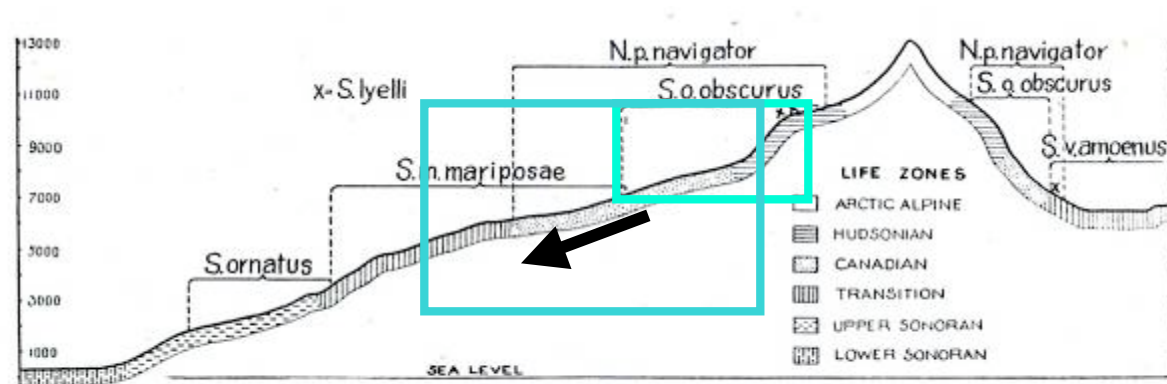
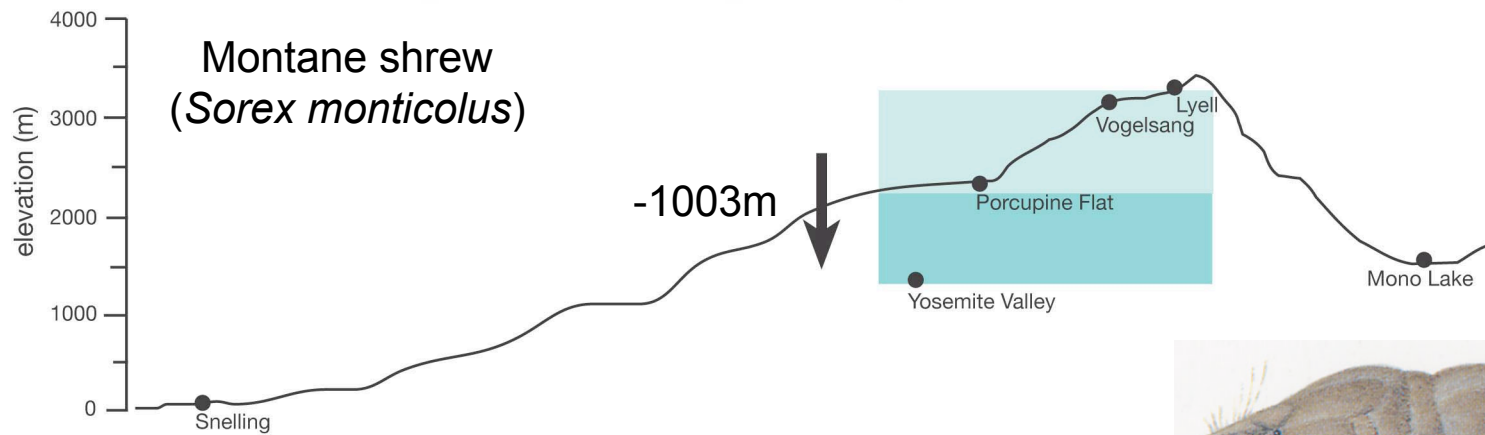
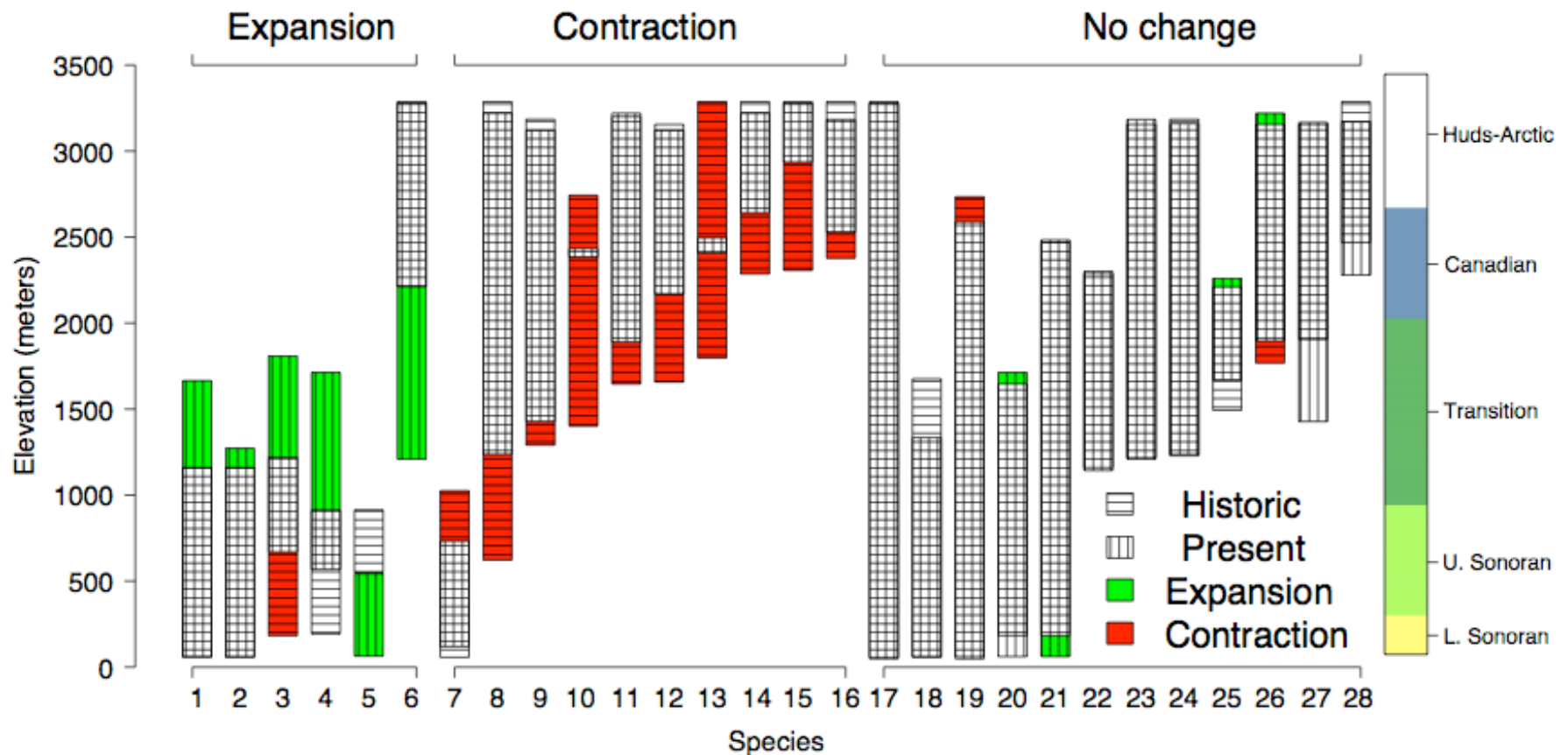


Fig. 6. Cross-section of the Sierra Nevada through the Yosemite region showing general zonal and altitudinal distribution of the shrews (genera *Sorex* and *Neosorex*).



50% of species have moved up, by ~500m on average
=> Contraction of high elevation species & expansion of low elevation species;
=> Changed community composition, but species diversity robust

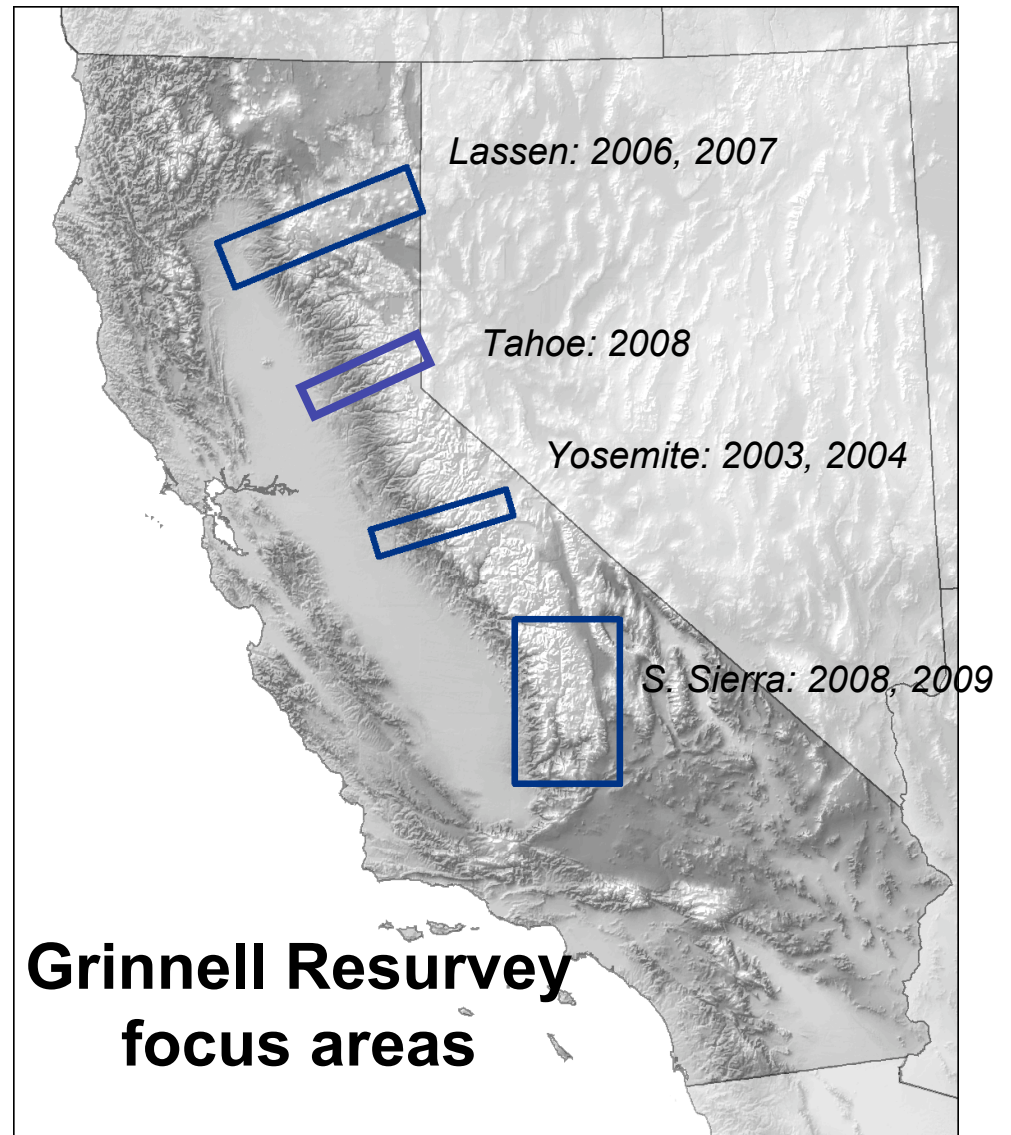


Resurveys of bird diversity (M. Tingley, S. Beissinger, A. Rush - see Poster #22 tonight)

MUSEUM OF VERTEBRATE ZOOLOGY CENSUS SHEET

Locality *Lassen Peak* Nature of route (zone, fauna, associations) *7300 to 8200 feet*
 Date *July 26, 1979*
 Observer *J. Grinnell*
 Time in field *7:20 to 12:10*
 Approximate no. miles *6 (by trail)* Weather *7300 to 8200 feet*
8200 to 8750 feet
8750 to 9500 feet
9500 to 10000 feet
10000 to 10950 feet

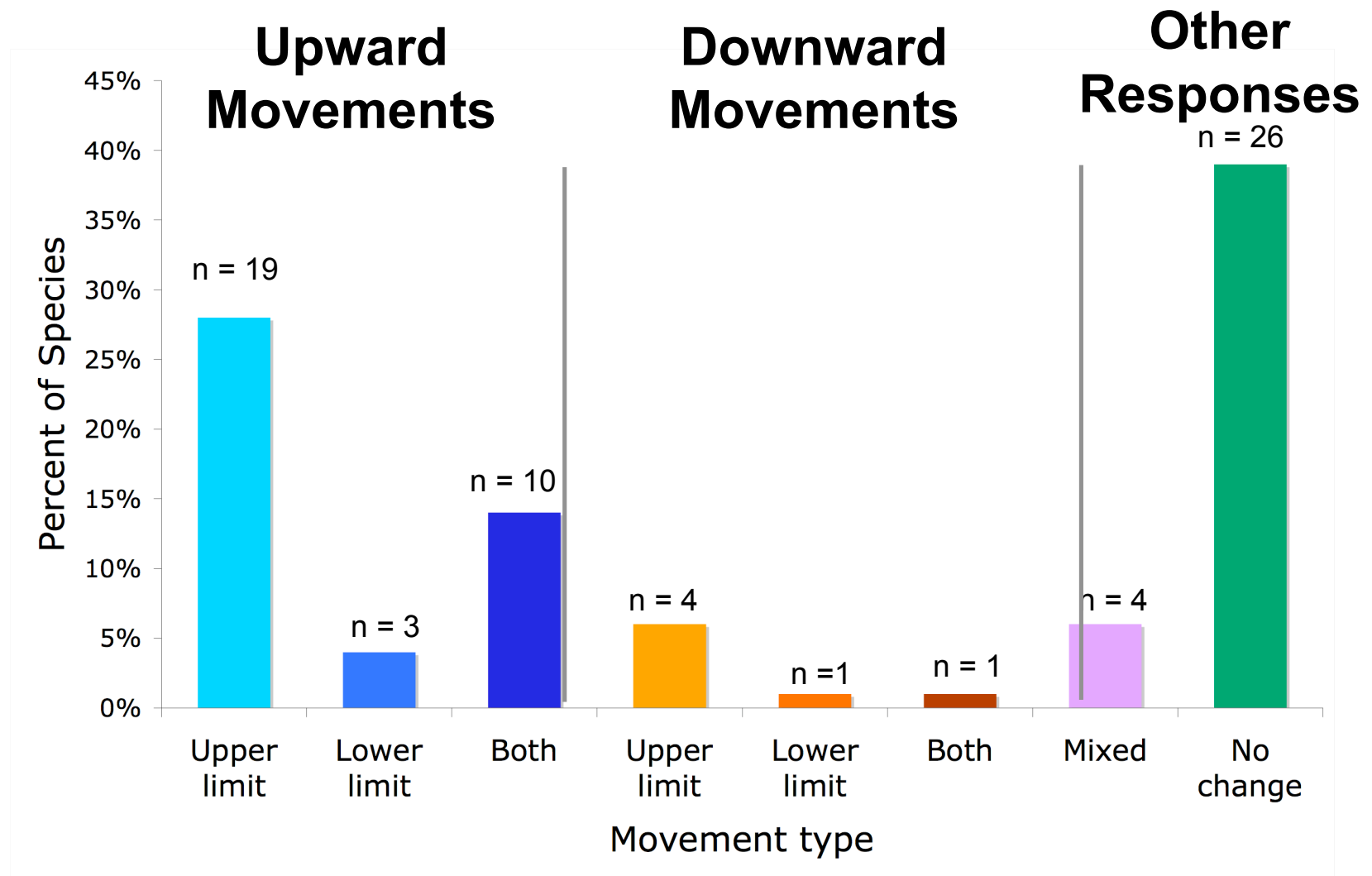
Species	Hours	7:20~	8:20~	9:20~	10:20~	11:20~12:10	Totals
Spotted Sandpiper		2					
Western Wood Pewee		4	3				
White-crowned Sparrow		3					
Western Robin		3	2				
Lincoln Sparrow		2					
Cassin Purple Finch		16	1				
Canada Nuthatch		3	1				
Audubon Warbler		3	6				
Sierra Junco		17	13				
Mountain Chickadee		7					
Pacific Chipping Sparrow		5					
Ruby-crowned Kinglet		2					
Pine Siskin		2					
Golden-crowned Kinglet		7+					
Townsend Solitaire		1					
Clark Nutcracker		2	11				
Arctic Three-toed Woodpecker		1					
Hairy Woodpecker		1					
Western Tanager			1				
Swinson Hawk				1	1		
Rock Wren						2	
TOTALS (hourly and grand)							



Summary of changes in elevation of 69 bird species:

⇒ Most low elevation species have expanded upwards;

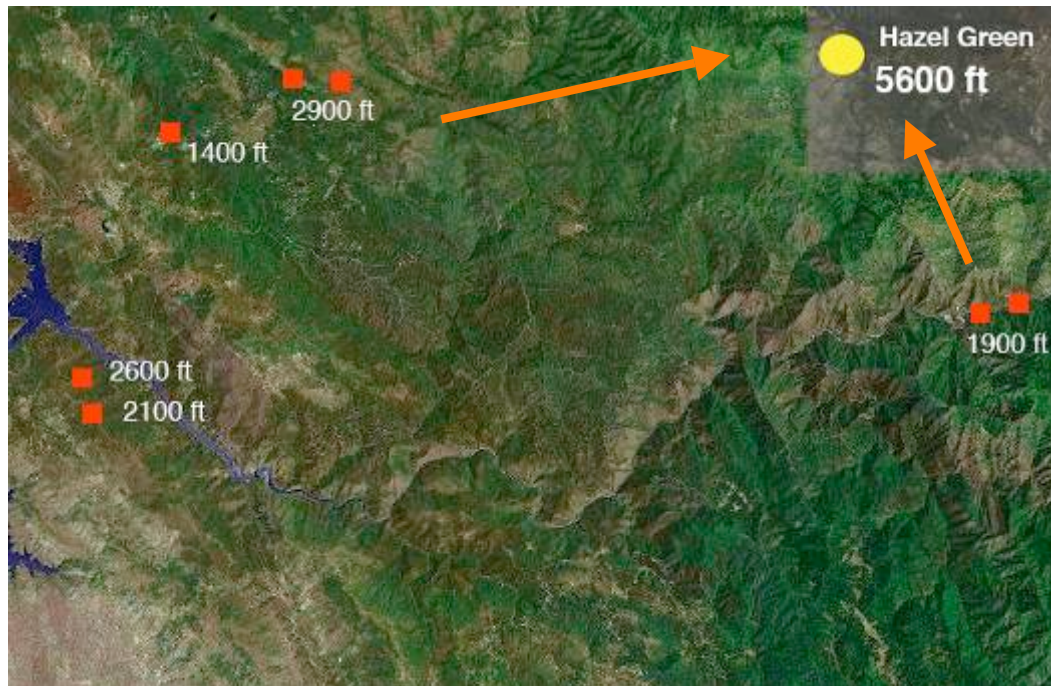
⇒ several high elevation species have contracted upwards



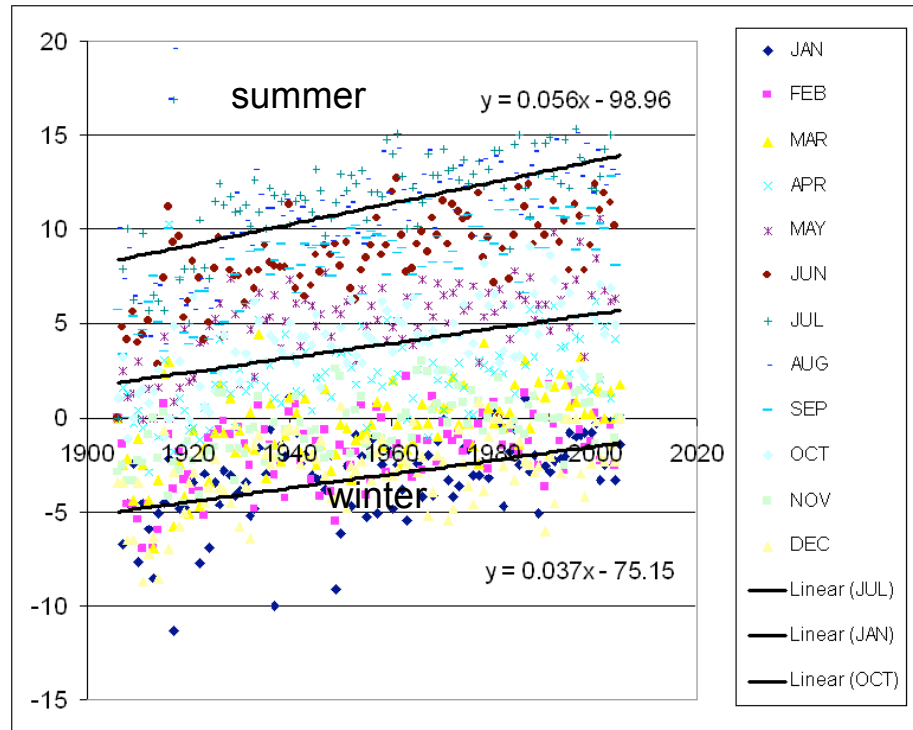
* 69 species selected *a priori* by several selection criteria, including: # observations, detectability, and inclusion in Grinnell monographs

Attribution: Effects of fire at low-mid elevation (e.g. California pocket mouse)

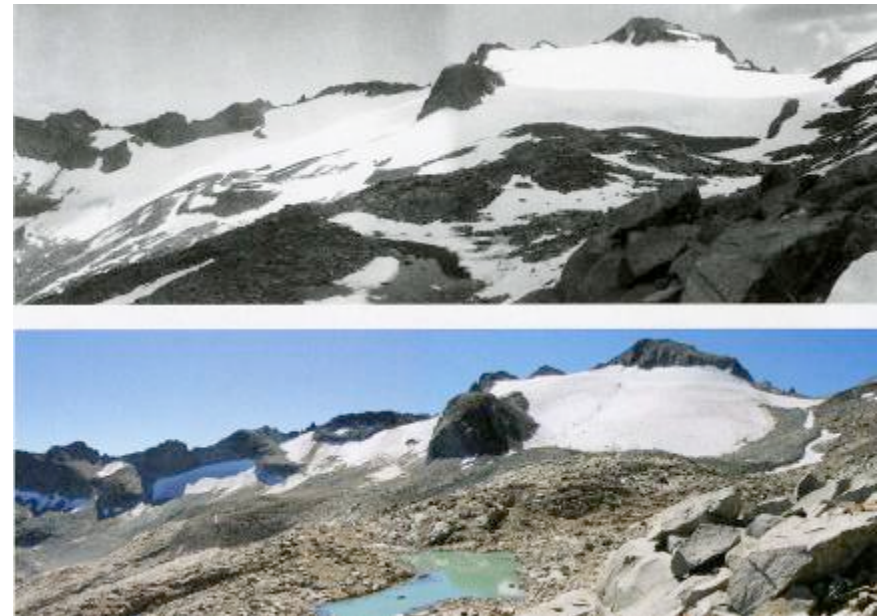
elevational increase of a low
elevation species



Attribution: Signatures of climate change: temperature increase, glacial melt



Yosemite Valley



Lyell Glacier, Yosemite National Park, in 1903 (top) and 2003 (bottom)

The central Sierra has warmed by 3-4 C over the past 100 years!

Response of Subalpine Conifers in the Sierra Nevada, California, U.S.A., to 20th-Century Warming and Decadal Climate Variability

Constance I. Millar,
Robert D. Westfall, and
Diane L. Delany
Sierra Nevada Research Center, Pacific
Southwest Research Station, USDA Forest
Service, 800 Buchanan St., Albany,
California 94710, U.S.A.
cmillar@fs.fed.us

John C. King
Laboratory of Tree-Ring Research,
University of Arizona, Tucson, Arizona
85721, U.S.A. Present address: Lone Pine
Research, Bozeman, Montana 59715,
U.S.A.

Lisa J. Graumlich
Big Sky Institute for Science and Natural
History, Montana State University,
Bozeman, Montana 59717, U.S.A.



forest densification

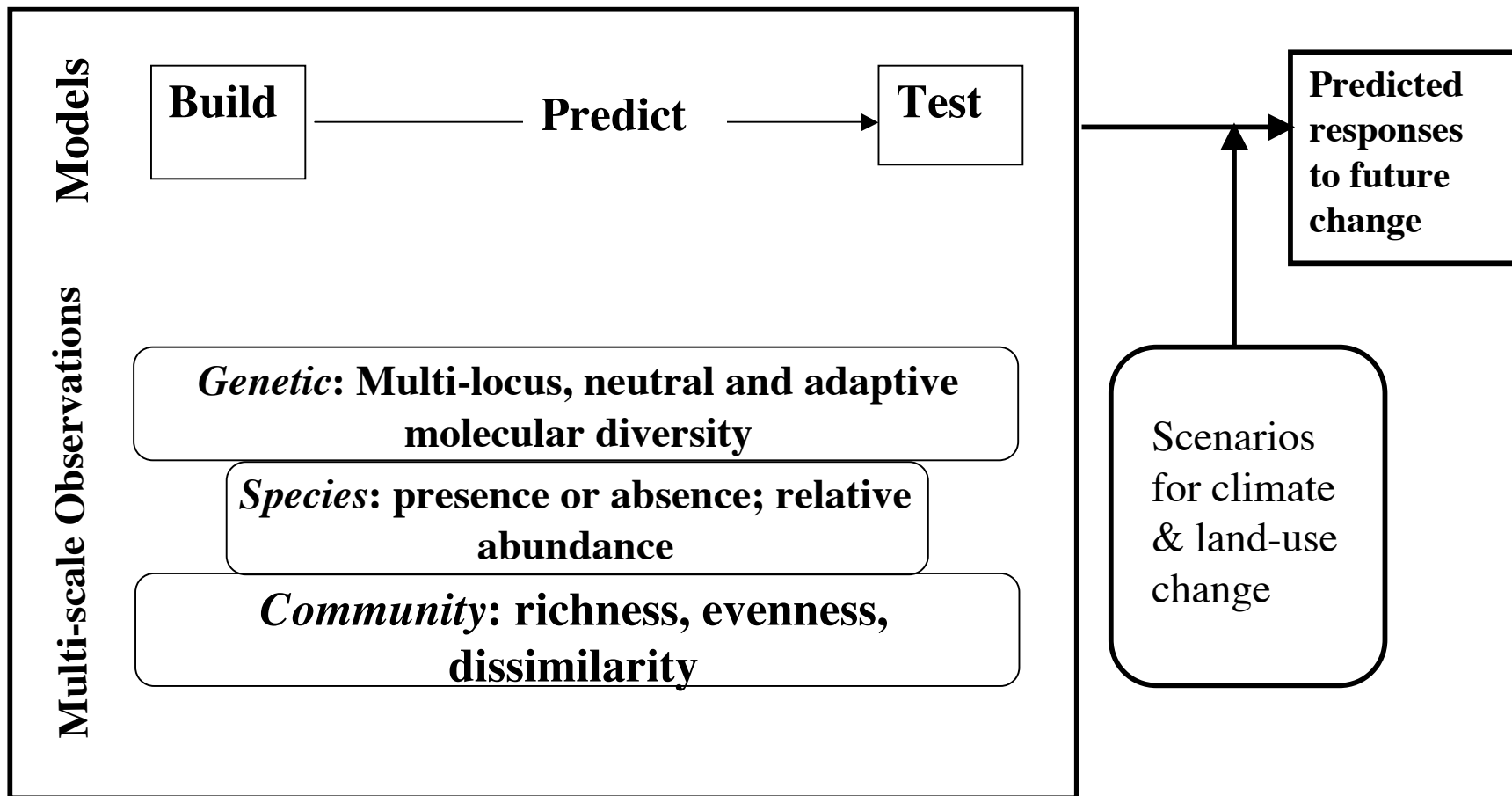
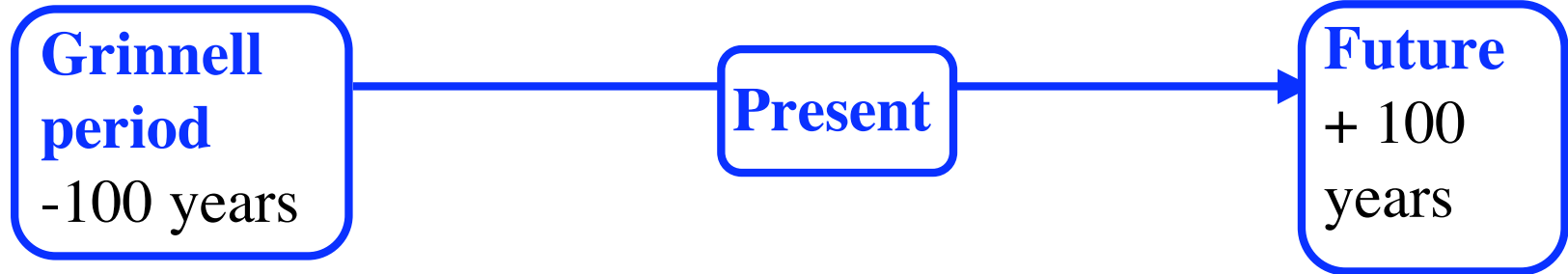
- increased tree density
- invasion of subalpine meadows

change in form & growth

- harsh conditions favor krummholz life form
- milder conditions favor persistence of flags and growth of upright stems



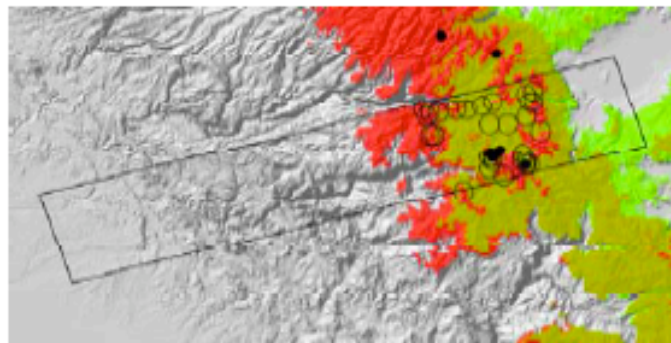
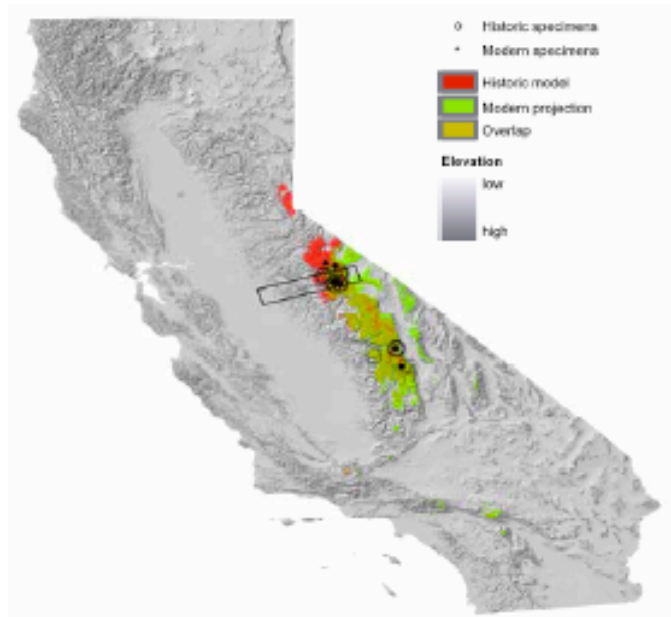
Using the past to inform the future



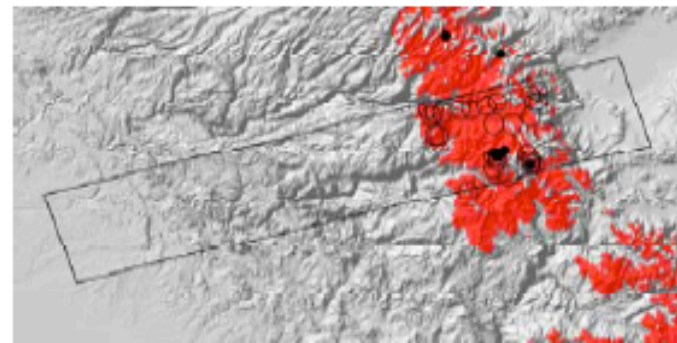
Model predictions: Grinnell -> present

Tamias alpinus

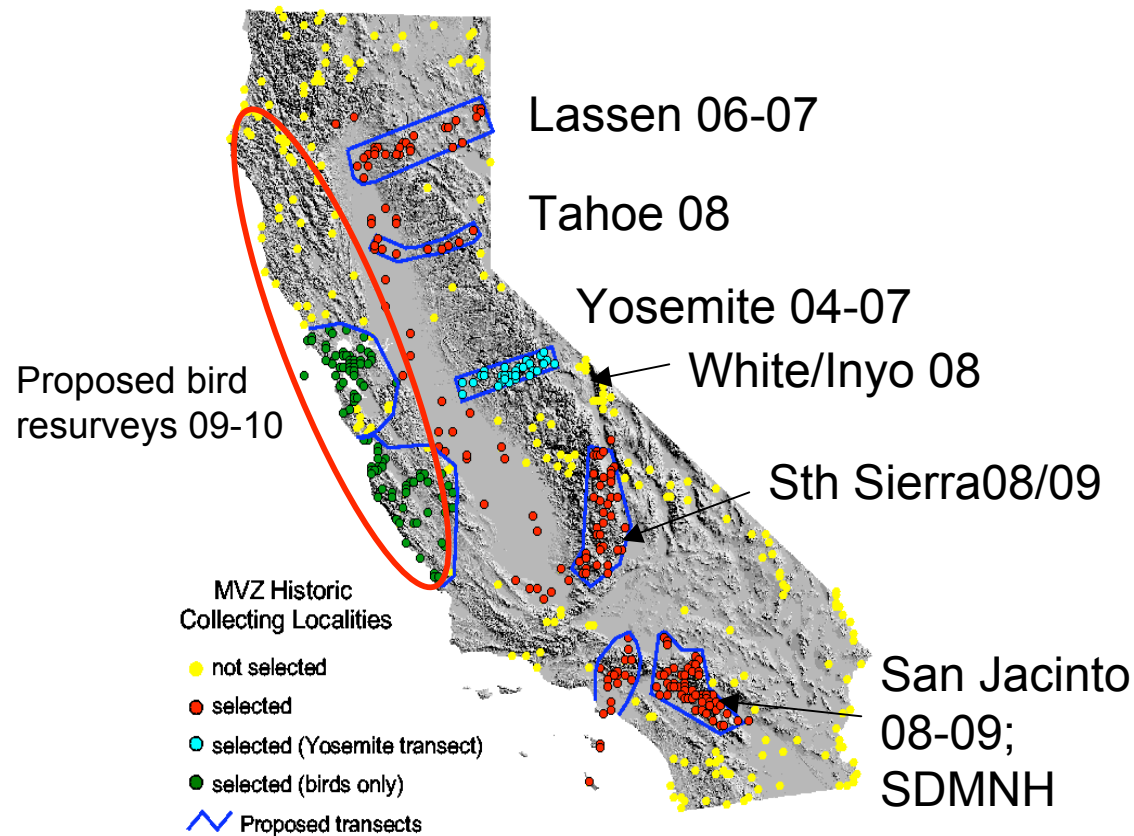
Maxent



BIOCLIM

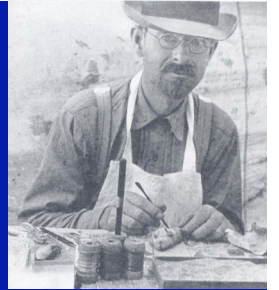


Grinnell project: status



- Continuing resurveys (2010+)
- Modelling past change (08-09)
- Predicting future change (09-10)

Concluding thoughts



Museums hold unique historical records that can reveal effects of environmental change

Comparisons of species distributions over 100 years are showing that:

- Some, but not all species are shifting ranges upwards by c. 500m elevation;
- Several high-elevation species are in trouble; and
- Changes in community composition - what are the consequences for ecological interactions & evolution?

Much of this is attributable to warming - we can use the record of the past to predict sensitivity to future change

Maintaining ecological integrity of elevation gradients is crucial to maintaining most species diversity.

Welcome to the MVZ website. Explore our collections, resources, research and educational activities...

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[Links, Affiliates, & Resources](#)

[Education & Outreach](#)



Search the MVZ web:

Highlights...

[Grinnell Resurvey Project](#)
A major effort by MVZ researchers to document changes in the vertebrate fauna of California over the past 100 years.

[Faculty/Curator Position](#)
The MVZ and IB Department seek an Assistant Professor and Assistant Curator in Vertebrate Evolutionary Biology.

[MVZ scientist rediscovers species of frog in Africa](#)
41 years after it first appeared in Sierra Leone, *Cardioglossa Aureoli* is rediscovered.

The Grinnell Resurvey Project

Studying the past, present and future of vertebrates in California.

"At this point I wish to emphasise what I believe will ultimately prove to be the greatest purpose of our museum. This value will not, however, be realized until the lapse of many years, possibly a century, assuming that our material is safely preserved. And this is that the student of the future will have access to the original record of faunal conditions in California and the west, where-ever we now work" (Joseph Grinnell, 1910)

California Biodiversity Threatened

California is a hotspot of species diversity and endemism (See, for example, the [Atlas of the Biodiversity of California](#)); with a high proportion of threatened species. Continuing conversion of wildlife habitat for development and agriculture, and accelerating impacts of climate change make it urgent that we understand how native species and communities respond to these pressures so that we can anticipate and, in some cases prevent, future changes to California's fauna.

The Grinnell Legacy

We are fortunate to have an extraordinary historical record, gathered for the purpose of understanding the distribution of species over time, which can be used to examine how patterns of diversity have changed over the past 100 years.

Between 1904 and 1940, the founding Director of the [Museum of Vertebrate Zoology](#) (MVZ), [Joseph Grinnell](#), and his colleagues documented and collected mammals, birds, amphibians and reptiles from >700 locations on multiple transects spanning much of the environmental diversity of California (see map below).

This work resulted in a remarkable snapshot of early 20th century diversity which includes >20,000 specimens, 13,000 pages of field notes, and 2,000 photographs.



Approach

As it approaches its Centenary (2008), the Museum of Vertebrate Zoology (MVZ) intends to realize Grinnell's goal through an extensive resurvey of vertebrate diversity at the sites he and his colleagues examined. Our aims are straightforward:

1. To document changes in communities and the geographic range and relative abundance of species;

changes in habitat, climate and invasive species and, some species sensitive and others resilient to

vertebrate diversity (at genetic, phenotypic, species continuing change and efforts from the conservation

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[? Query](#) specimen database [? Query](#) reprint data

www.mvz.berkeley.edu

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Forthcoming publication on Yosemite transect mammals: Moritz et al. *Science*, in press.